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DESIGN OF A HALF TON DEHYDRATOR FOR FISH

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[A half-ton capacity artificial dryer has been designed at the Central Institute of Fisheries Technology for drying fish like Mackerel, Sardine, White Bait etc. The dryer is a hot air re-circulation type. 80 K. W. thermostatically controlled heating coils are made use of for heating the air. The air is circulated by means of an axial flow pattern fan. Drying takes place at a temp. of 115°F. The structure of the dryer to be made of Anjili wood. The cost of one dryer comes to about Rs. 20,000/-]

Introduction

Sun-drying of fish has been a traditional process of fish preservation in mos of the countries in the world. Inspite of the more sophisticated processes of fish preservation such as canning and freezing, sun-drying still retains its significance in the industry. Large quantieties of fish of various varieties are being sundried for human consumption. The process, however, is slow and generally gives a product lower in nutritional value. Apart from this the product invariably contains higher percentage of moisture which decreases its storage life. It may also be contaminated with pathogenic bacteria like salmonella due to the attack by flies and with sand and dirt.

It has been observed that this product can be produced better in quality in all respects when processed under controlled conditions in the hot-air dryers. Mechanical drying with hot air removes most of the draw-backs in sun-drying. Investigations carried out at the Central Institute of Fisheries Technology has shown that the process of drying in the mechanical hot-air dryers is economical and commercially feasible. Hence the design of a commercial type of an artificial dryer was taken up.

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General Considerations.

Since fish is generally landed in small quantities all along the coast, the capacity of the dryer has been taken as half a ton of fresh fish per loading.

Moisture carrying capacity of air increases the temperature. For the drying operations, therefore, the highest possible temperature should be used without effecting the material. It was observed from experiments that the optimum temperature for drying of commercial fish like Mackerel, Sardines, White Baits and Silver Bellies is about 45°C at 50% RH. At higher temperatures the fish suffer from cooking effects.

Psychrometric chart indicates that the difference between the dry and wet bulb temperatures increases with the temperature of the air eventhough the absolute humidity remains constant. Basing on this principle a controlled electrically heating unit was installed in the dryer. The danger of over-heating the product and the air was thus eliminated.

Relative Humidity appreciably influenced the drying rate mainly during the first part of the drying operation, that is, when the surface of the fish was wet. To avoid case-hardening it was necessary to use a low Relative Humidity in the beginning and to increase it during the later part of the operation. It was also observed that keeping Relative Humidity constant at 50% throughout the operations, it was possible to dry the fish efficiently. Most of the fishes that are used for drying contain moisture in the range of 75 to 80 percent. For the designing purpose the initial moisture content in the fish was assumed to be 80% (weight basis).

Details of the Dryer.

The following are the dimensions of the dryer:-

20'- over-all length; 8' 3"-average height and 5' 9"-width. The body of the dryer made of wood (Anjili) has been found to be suitable for the purpose. It will take half ton of fresh fish per batch. The drying chamber consists of 3 compartments of 4' 6" long 5'9" high and 5' wide. An axial flow pattern fan of 3' diameter with for intersecting blades is situated on the top of the drying chamber. The fan will circulate about 10,000 cu. ft. of air per minute at 1400 revolutions per minute. The fan is driven by 3/4H-P. 3 phase electric motor.

To produce a system of uniform velocity over the whole cross-section of the tunnel dryer, aerofoils are provided as shown in the figure 1. The circulating air after passing through the drying chamber turns back to the top duct where the circulating fan is placed through the aerofoils. There are inlet manifold and out let manifold which could be controlled by butterfly valves fixed to it. Both the air intake and exhaust air can be maintained to circulate by adjusting the butterfly valves. The R. H. in each drying chamber is maintained by controlled recirculation of the air. About $\frac{1}{12}$th of the drying air is exhausted in the cycle according to the requirements and a corresqonding amount of air is replaced in each cycle. The air is heated by 65 KW thermostatically controlled electric coils fixed in the front of the circulating fan. The heating coils will raise the temperature of the circulating air by about 31°F-(16°C). Another heating coil of 15 KW capacity is

placed at the end of the drying chamber. This works as a reheater coil. The reheater coil raises the temperature of the air that has already passed through the drying chambers. The heating coil are controlled thermostatically within a range of +2°F. The drying chamber is provided with angle iron trolleys to carry the trays loading the fish. Each trolley is 5' 2" long 5' 8" high and 4' wide and holds 28 trays of size 4' x 2' 4", each tray will hold 14 pounds of fish. Inside the drying chamber tracks are provided for trolley wheels for easy movement of the trolleys. The trolleys after loaded with fish can be pushed inside the drying chamber. The fish trays are made of galvanised iron wire mesh on wooden frames. The compartments of the drying chamber are provided with air-tight doors. The details of the design of the trolleys and trays are given in the attached figures. The fabrication of such a dryer is simple and can be carried out locally.

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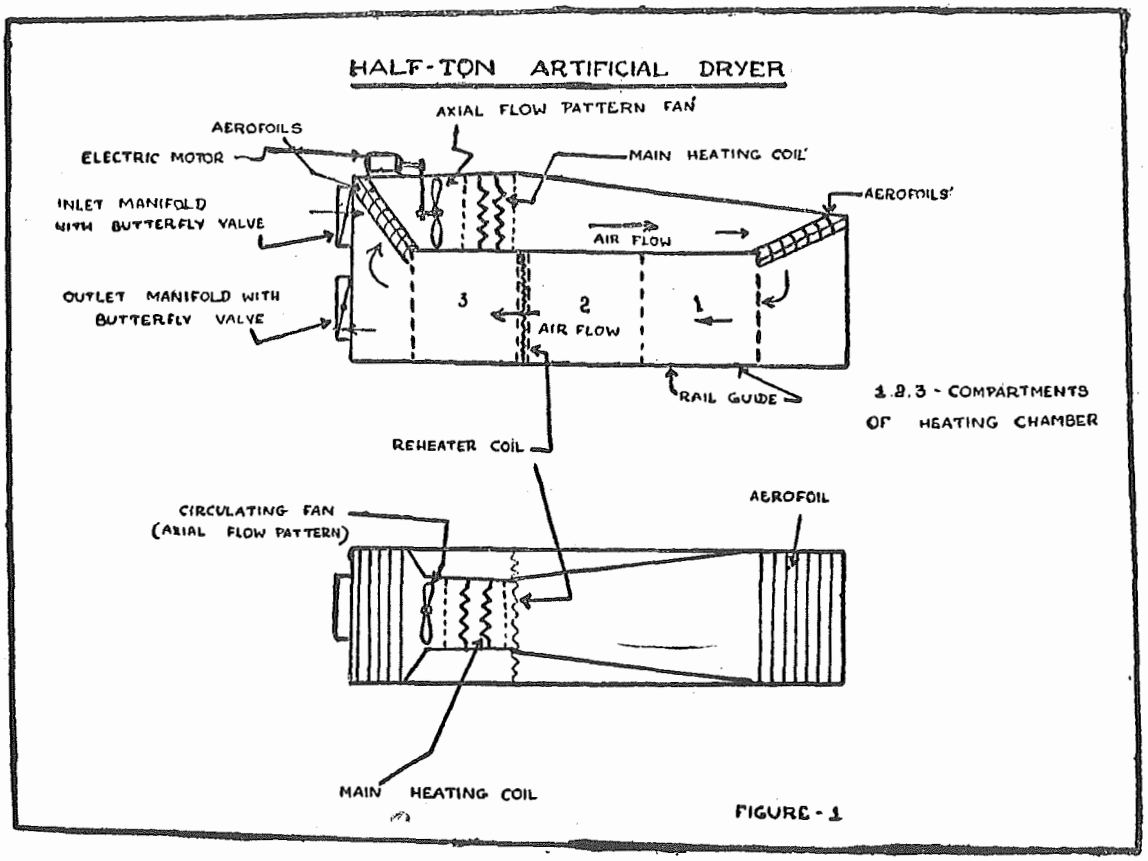
HALF-TON ARTIFICIAL DRYER
AXIAL FLOW PATTERN FAN
AEROFOILS
ELECTRIC MOTOR
MAIN HEATING COIL
AEROFOILS
INLET MANIFOLD WITH BUTTERFLY VALVE
AIR FLOW
OUTLET MANIFOLD WITH BUTTERFLY VALVE
3
2
1
AIR FLOW
RAIL GUIDE
1.2.3 - COMPARTMENTS OF HEATING CHAMBER
REHEATER COIL
CIRCULATING FAN (AXIAL FLOW PATTERN)
AEROFOIL
MAIN HEATING COIL

FIGURE - 1